REMARKS

By the present amendment, Claims 1, 5, 9 and 10 have been amended. Claims 1-15 remain pending in the present application. Claims 1, 5 and 10 are independent claims. Applicants request reconsideration and allowance in view of the foregoing amendments and the following remarks.

1. Claims 1-4 are objected to because of informalities. In particular, the Office Action noted that Claim 1 should be written as that of a method claim, which would have steps for performing the surface treatment. Claims 1-4 have been amended to overcome this objection.

2. Claims 1 and 3 are rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by Moustakas (U.S. Patent No. 5,847,397). Applicants respectfully traverse this rejection.

Applicants have amended Claim 1 to more particularly define Applicants' claimed invention in view of the prior art of record. Applicants respectfully submit that the amendments to the claims are fully supported by the original disclosure, and introduce no new matter therewith.

Amended independent Claim 1 recites a surface treatment method for a compound semiconductor layer including nitrogen. The method removes part of the compound semiconductor layer by dry etching, and performs a nitrogen plasma treatment step to recover from damage due to nitrogen vacancies arising in a surface of the compound semiconductor layer as a result of the dry etching.

The non-etching nitrogen plasma surface treatment taught by Moustakas is an electron cyclotron resonance microwave plasma-assisted molecular beam epitaxy (ECR-MBE) method used for the purpose of growing a crystalline gallium nitride (GaN) layer. The deposited GaN includes a buffer layer deposited on the substrate and a single crystal film deposited on the buffer layer (col. 1, lines 51-59). To prevent nitrogen vacancies in the buffer layer, the nitrogen is formed at a temperature of 600 degrees C (as noted in col. 5, line 45). The substrate is then kept at this temperature for thirty minutes in the presence of nitrogen plasma to ensure that the GaN buffer layer crystallizes (col. 5, lines 49-51).

The present invention address a problem encountered in the formation of high electron mobility GaN transistors. During the transistor formation process, the GaN wafer does not undergo a high-temperature crystal growth process, but transistor gates are formed by a recess etching step using an etching gas (that is, the etching step is a dry etching step) that produces chemical damage. To clean the etched recesses of etching gas species, the wafer is annealed at a temperature of at least 400 degrees C for at least twenty minutes (see page 11, lines 21-24 of the specification). Nitrogen vacancies form in the exposed AlGaN layer during these steps.

At the time the invention was made, GaN compound semiconductor materials were though to be chemically stable and mechanically strong because of the strength of the Ga-N bond, the high crystal melting point, and the high growth temperature. It was not easy to foresee that a dry etching step carried out at a much lower temperature would produce nitrogen vacancies. The discussion of nitrogen vacancies by Moustakas in col. 4, lines 29-42 and col. 15, lines 14-20, for example, attributes nitrogen vacancies to high-temperature crystal growth processes and teaches that growth processes at lower temperatures should reduce the number of nitrogen vacancies.

While Moustakas teaches a method of avoiding the formation of nitrogen vacancies, the claimed invention is concerned with recovering from nitrogen vacancies that have already been formed as a result of a dry etching process. Amended Claim 1 makes this distinction clear. Applicants respectfully submit that Moustakas nowhere teaches or reasonably suggests that nitrogen vacancies might form as a result of dry etching or that nitrogen plasma treatment might be useful for recovering from such nitrogen vacancies.

It is well known that for a reference to anticipate a claim under 35 U.S.C. § 102(b) there must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention (see *Scripps Clinic & Research Foundation v. Genentech Inc.*, 18 USPQ 2d 1001, 1010 (Fed. Cir. 1991). The application of Moustakas by the Office Action fails to meet this criteria, and amended Claim 1 is allowable over Moustakas. Claim 3 is allowable as being dependent from an allowable claim.

Applicants respectfully request reconsideration and withdrawal of the rejection of Claims 1 and 3 under 35 U.S.C. § 102(b) as being anticipated by Moustakas.

3. Claims 5, 6, 8, 10, 11, 13 and 15 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over admitted prior art and Moustakas. Applicants respectfully traverse this rejection.

Applicants have amended Claims 5 and 10 to more particularly define Applicants' claimed invention in view of the prior art of record. Applicants respectfully submit that the amendments to the claims are fully supported by the original disclosure, and introduce no new matter therewith.

Amended independent Claim 5 recites a surface treatment method for a compound semiconductor layer. The compound semiconductor layer includes a first compound semiconductor layer including nitrogen and a second compound semiconductor layer formed on and differing in composition from the first compound semiconductor layer. The method removes part of the second compound semiconductor layer by dry etching to partially expose a surface of the first compound semiconductor layer, and performs a nitrogen plasma treatment step to recover from damage due to nitrogen vacancies arising in the exposed surface of the first compound semiconductor layer as a result of the dry etching.

Amended independent Claim 10 recites a method of fabrication of a semiconductor device, the method. The method forms a compound semiconductor multilayer on a substrate. The compound semiconductor multilayer has a first compound semiconductor layer formed including nitrogen and a second compound semiconductor layer formed on and differing in composition from the first compound semiconductor layer. A first main electrode and a second main electrode are formed on the second compound semiconductor layer, the first and second main electrodes being mutually separated by a certain distance. An area of the second compound semiconductor layer is removed between the first main electrode and second main electrode by dry etching to expose a surface of the first compound semiconductor layer. The partially exposed first compound semiconductor layer is annealed. At least part of the exposed surface

area of the first compound semiconductor layer is treated with nitrogen plasma to recover from damage due to nitrogen vacancies arising in the exposed surface of the first compound semiconductor layer as a result of the dry etching. A gate compound semiconductor layer is then formed.

The Office Action concedes that the admitted prior art does not teach a nitrogen plasma treatment step to recover damage due to nitrogen vacancies arising in the exposed AlGaN surface. The Office Action relies on col. 5, lines 39-48 in Moustakas for teaching a surface treatment for a compound semiconductor comprising treating the surface with a non-etching nitrogen plasma to reduce the formation of nitrogen vacancies. The Office Action asserts that it was recognized at the time the invention was made to treat compound semiconductor with N2 plasma because it reduces the formation of nitrogen vacancies.

Applicants respectfully submit that in col. 5, lines 46-48, Moustakas only suggests that "nitrogen overpressure also helps reduce the formation of nitrogen vacancies." Moustakas only states that "nitrogen overpressure" helps reduce the formation of nitrogen vacancies, not recovering from damage due to nitrogen vacancies arising in a surface of the compound semiconductor as a result of dry etching, as alleged by the Office Action. As previously explained, Moustakas nowhere teaches or reasonably suggests that nitrogen vacancies might form as a result of dry etching or that nitrogen plasma treatment might be useful for recovering from such nitrogen vacancies. Thus, amended Claims 5 and 10 are allowable over the admitted prior art and Moustakas.

Claims 6, 8, 11, 13 and 15 variously depend from Claims 5 and 10 and are allowable as being dependent from an allowable claim.

Applicants respectfully request reconsideration and withdrawal of the rejection of Claims 5, 6, 8, 10, 11, 13 and 15 under 35 U.S.C. § 103(a) as being unpatentable over admitted prior art and Moustakas.

4. Claims 2, 7 and 12 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Moustakas or admitted prior art/Moustakas in view of Lee (U.S. Patent No. 6,762,083). Applicants respectfully traverse this rejection.

Claims 2, 7 and 12 variously depend from Claims 1, 5 and 10 and are allowable as being dependent from an allowable claim.

Further, Lee describes a method for manufacturing an AlGaN/GaN HFET device which is capable of easily forming a fine gate electrode. Lee fails to supplement the deficiencies of Moutakas because Lee fails to teach or reasonably suggest that nitrogen vacancies might form as a result of dry etching or that nitrogen plasma treatment might be useful for recovering from such nitrogen vacancies.

Applicants respectfully request reconsideration and withdrawal of the rejection of Claims 2, 7 and 12 under 35 U.S.C. § 103(a) as being unpatentable over Moustakas in view of Lee.

5. Claims 4, 9 and 14 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Moustakas or admitted prior art/Moustakas in view of Gilbert et al. (U.S. Patent Application Publication No. US 2002/0072223 A1). Applicants respectfully traverse this rejection.

Claims 4, 9 and 14 variously depend from Claims 1, 5 and 10 and are allowable as being dependent from an allowable claim.

Further, Gilbert et al. describes a method of fabricating a ferroelectric memory device. Gilbert et al. fails to supplement the deficiencies of Moutakas and Applicants' admitted prior art because Lee fails to teach or reasonably suggest that nitrogen vacancies might form as a result of dry etching or that nitrogen plasma treatment might be useful for recovering from such nitrogen vacancies.

Applicants respectfully request reconsideration and withdrawal of the rejection of Claims 4, 9 and 14 under 35 U.S.C. § 103(a) as being unpatentable over Moustakas in view of Gilbert et al.

6. For the obviousness rejection of Claims 2 and 4-15 the motivation to combine the references is leading.

In order to establish a prima facie case of obviousness, all of the claimed limitations must be taught or suggested by the prior art, and there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the references or to combine the reference teachings. *In re Vaek*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

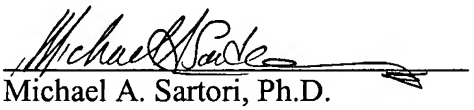
Regarding Claims 2 and 4-9, Applicants respectfully submit that Moustakas, Lee, Gilbert et al., or any combination thereof provides no motivation whatsoever to modify the teachings thereof to provide a surface treatment method for a compound semiconductor layer, the compound semiconductor layer including nitrogen, the method including removing part of the compound semiconductor layer by dry etching; and performing a nitrogen plasma treatment step to recover from damage due to nitrogen vacancies arising in a surface of the compound semiconductor layer as a result of the dry etching.

Regarding Claims 10-15, Applicants also respectfully submit that Moustakas, Lee, Gilbert et al., or any combination thereof provides no motivation whatsoever to modify the teachings thereof to provide a method of fabrication of a semiconductor device, the method including forming a compound semiconductor multilayer on a substrate, the compound semiconductor multilayer having a first compound semiconductor layer formed including nitrogen and a second compound semiconductor layer formed on and differing in composition from the first compound semiconductor layer; forming a first main electrode and a second main electrode on the second compound semiconductor layer, the first and second main electrodes being mutually separated by a certain distance; removing an area of the second compound semiconductor layer between the first main electrode and second main electrode by dry etching to expose a surface of the first compound semiconductor layer; annealing the partially exposed first compound semiconductor layer; treating at least part of the exposed surface area of the first compound semiconductor layer with nitrogen plasma to recover from damage due to nitrogen

vacancies arising in a surface of the compound semiconductor layer as a result of the dry etching; and forming a gate compound semiconductor layer.

7. For the foregoing reasons, Applicants respectfully submit that the present application is in condition for allowance. If such is not the case, the Examiner is requested to kindly contact the undersigned in an effort to satisfactorily conclude the prosecution of this application.

Respectfully submitted,



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